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Particles and Fields—Magnetosphere

5730 Interactions between solar wind and magnetosphere
COMPARISON OF 53-3 POLAR CAP POTENTIAL DROPS WITH THE INTERPLANETARY MAGNETIC FIELD AND MODELS OF MAGNETOPAUSE RECONNECTION
J. R. Wygant (Space Sciences Laboratory, University of California, Berkeley, California, 94720), R. B. Torbert, and F. S. Mozer

Measurements of the cross polar cap electric potential, by the double probe electric field experiment aboard S3-3, from fifty-five orbits in the dawn-dusk plane are compared to the reconnection electric fields predicted by a variety of models, both theoretical and experimental. The purpose of these comparisons is to understand the extent to which reconnection contributions to the polar cap potential must be included, to determine the time response of the polar cap potential to time varying reconnection rates, and to determine the efficiency and saturation levels of the reconnection process.

It is found that (1) After several hours of northward interplanetary magnetic field, the cross polar cap potential declines to progressively lower values than those after one hour of northward interplanetary magnetic field. This suggests that it requires several hours for the ionospheric polar cap potential to respond to the "turning off" or "turning down" of the reconnection process. (2) The decay of the polar cap potential is timed to demonstrate that contributions to the polar cap potential not associated with the reconnection process can be finished in less than 20 kilovolts. It is shown that contributions to the polar cap potential that scale with the dynamic pressure of the solar wind are limited to less than one kilovolt. (3) The cross polar cap electric potential is best predicted by a weighted sum of contributions from interplanetary magnetic field parameters over the final hours previous to the measurement. The weighting functions have the form of an exponential decay of two to three hours with the strongest weight on interplanetary parameters over the one hour previous to the measurement. (4) For values of the dawn dusk component of the interplanetary electric field less than about 0.5 mV/meter, the measured polar cap potential is consistent with reconnection of all the interplanetary magnetic flux incident on a 30Rg wide frontside magnetopause. For larger values of the dawn dusk component of the interplanetary electric field, the proportion of field lines reconnecting is less, indicating saturation of the reconnection process.

The above results are obtained when the extended response time of the magnetosphere to changes in interplanetary parameters is considered. They are independent of the detailed reconnection model assumed, and they are quite different from the viscous constribution, saturation levels of reconnection, and reconnection efficiencies inferred from comparisons of polar cap potentials to single hour averages of interplanetary parameters.

J. Geophys. Res., Blue, Paper 3A0277.

5725 [Interactions Between Magnetosphere and Cosmic Rays]
NUCLEAR CASCADES IN SATURN'S RINGS: COSMIC RAY AND ALBEDO NEUTRON DECAY AND THE ORIGINS OF TRAPPED PROTONS IN THE INNER MAGNETOSPHERE
John F. Cooper (Corlon Fermi Institute, University of Chicago, 933 E. 56th Street, Chicago, Illinois 60637)

The nearly equatorial trajectory of the Pioneer II spacecraft through Saturn's high energy proton radiation belts and under the main A-B-C rings provided a unique opportunity to study the radial dependence of the > 30 MeV proton intensities in the belts in terms of models for secondary nucleon production by cosmic ray interactions in the rings, *in-situ* proton injection in the radiation belts by neutron beta-decay, magnetospheric diffusion, and absorption by planetary rings and satellites. Maximum trapped proton intensities measured by Pioneer II in the radiation belts are compared with calculated intensities and found consistent with trapping times of 40 years and a radial diffusion coefficient $D_{LL} \approx 10^{-9}$/sec. Differential energy spectra of protons between 30 and 500 MeV are consistent with the power law energy spectra ($E^{-\gamma}$) measured by Trag-Beta decay model, but an inferred harmonic of the spectra towards lower energies, and reported integral proton measurements of the form $(E_{min} + \text{constant})^{-\gamma}$, both indicate the need for more realistic calculations of the neutron source from the rings and the radiation belt loss processes. [cosmic rays, planetary rings, neutron decay, radiation belts].

J. Geophys. Res., Blue, Paper 3A0278.

5735 Plasma instabilities
ION-BEAM-DRIVEN ELECTROSTATIC ION CYCLOTRON INSTABILITIES
A. Hirata (Geophysics Research Laboratory, University of Tokyo, Bunkyo-ku, Tokyo, 113 Japan), H. Okuda and M. Ashour-Abdalla

We present results of numerical simulations of electrostatic ion cyclotron instabilities driven by an ion beam parallel to the magnetic field. For beam speed exceeding the thermal speed of the background ions and beam temperature much lower than the background ion temperature, it is found that the instability results in strong perpendicular heating and slowing down of the parallel drift of beam ions, leading to the saturation of the instability. Applications to plasma heating and space plasma physics are discussed. (Ion beams, ion electrostatic waves, kerzel instabilities).

Geophys. Res. Lett., Paper 3L0323

5755 Plasma instabilities
HALTE WAVE MODEL FOR GEOMAGNETIC PULSATIONS IN A HIGH β PLASMA
V.L. Patel, P.R. Ng (Department of Physics, University of Denver, Denver, CO 80208) and L.J. Cahill, Jr. (Space Science Center, University of Minnesota, Minneapolis, MN 55455)

A dispersion relation for the stability of the coupled drift compressional, drift mirror and shear Alfvén waves in the magnetospheric plasma is analyzed by numerical method. The analysis is suitable for the storm-time plasma conditions in the magnetosphere which usually has gradients in plasma density, temperature, magnetic field and anisotropy in temperature. The effect of high β which is characteristic of storm-time plasma is included in the model. For a given appropriate set of plasma parameters, and wave parameters of a mode, relative wave amplitudes are calculated from the model. A comparison is made of model generated and observed relative wave amplitudes by using two sample wave events observed by Explorer 45 during August 4-5, 1972 magnetic storm. The quantitative analysis shows good agreement between theory and observations for a gradient-driven Alfvén-like instability whenever growth rates are very small for this mode. The anisotropy-driven drift mirror instability has large growth rates, but does not show good correlation between theory and observations of relative wave amplitudes. (Drift wave instabilities, geomagnetic pulsations).

J. Geophys. Res., Blue, Paper 3A0400

5770 Short-period variations of magnetic field
CORRELATED IRREGULAR MAGNETIC PULSATIONS AND OPTICAL EMISSION OBSERVED AT SIPLE STATION, ANTARCTICA
R. J. Engebretson (Dept. of Physics, Augsburg College, Minneapolis, MN 55454), L. J. Cahill, Jr., R. L. Arnoldy, A. B. Wende, and T. J. Rosenberg

Pi 1 magnetic pulsations observed at Siple Station, Antarctica, contain an unusual class of fluctuations. They are large amplitude, 0.2-1 nT/s, one-sided pulsations in shape with variable direction. The pulsations are from 2 to 10 s wide and occur in an irregular train of pulses that lasts, sporadically, up to an hour. An earlier study (Arnoldy et al., 1974) reported that in 1970 data these pulses were often closely associated with riometer and auroral pulsations. The present report extends that work using 1980 data and describes the variety in observation of these pulsations. The pulsations are observed from 220° local time until noon with most frequent occurrence near dawn. They usually occur during or shortly after a burst of high frequency pulsations activity which is long duration (several hours) interval of large or moderate amplitude Pi. Although the direction of the pulsations is typically west or northwest, other directions are also observed. From north to south occurring in a few minutes. The interpre- tation views Pi 1 pulsations as the result of local enhancements in ionospheric conductivity in patches associated with precipitating electrons responsible for the associated pulsations in auroral luminosity. We estimate that a typical patch must have a minimum conductivity of about 1 mho, moving as a unit with the background plasma, and having an east-west extent of about 100 km. (Pi 1 pulsations, auroral pulsations, magnetic pulsations, correlated pulsations, traveling ionospheric disturbances).

J. Geophys. Res., Blue, Paper 3A0310

Planetology

6510 Atmospheres of Planets
ELECTRON PRECIPITATION AND RELATED AERONOMY OF THE JOVIAN THERMOSPHERE AND IONOSPHERE
J. Hunter Waite, Jr. (Space Science Laboratory, NASA/Marshall Space Flight Center, AL 35812), T. E. Cravens, J. Kozyra, A. F. Nagy, S. K. Atreya, and R. Y. Chen

Voyager Ultraviolet Spectrometer (UVS) measurements provided the first unassailable evidence for particle precipitation in the Jovian atmosphere. Strong low and variable band emissions of high latitudes indicate that particle precipitation energy fluxes of about 10 ergs cm^{-2} s^{-1}. On the other hand daytime hydrogen and hydrocarbon emissions at mid- and low-latitudes may indicate additional particle precipitation fluxes on the order of 0.3 ergs cm^{-2} s^{-1} at all latitudes. Such particle precipitation can have significant aeronomical effects on the Jovian thermosphere and ionosphere. A one-dimensional theoretical model is used to study the effects of, for the case of electron precipitation, along ion precipitation produces similar effects.

Auroral electron precipitation by 10 keV electrons with a total energy flux of 10 ergs cm^{-2} s^{-1} produces 2 x 10^{11} H atoms cm^{-2} s^{-1} and 5 ergs cm^{-2} s^{-1} of heat. Thus, Jovian auroral H production is 2 orders of magnitude larger than which accompanies 7.5 x 10^{9} H atoms cm^{-2} s^{-1} and 0.02 ergs cm^{-2} s^{-1} of heat. Thus, Jovian auroral H production is coupled with aurorally driven meridional winds in the thermosphere can possibly explain the high concentrations of atomic hydrogen in the low-latitude dayside upper atmosphere. Furthermore, aurorally heated gases of composition can create important feedback effects on the relative airglow efficiences and heating rates in the high-latitude thermosphere. In addition, ion-neutral and vibrational excitation of H$_2$ from precipitation processes appear to play a central role in determining the structure of the high-latitude ionosphere. Theoretical fits to the Voyager radio occultation electron density profiles at high latitudes require a 10-keV electron source with an energy flux of 0.1 ergs cm^{-2} s^{-1} coupled with a height-dependent K_{eddy} and temperature which reaches 3000° K in the upper ionosphere. (Jupiter, aurora, atomic hydrogen, ionosphere).

J. Geophys. Res., Blue, Paper 3A0222

6599 General or Miscellaneous
ENERGETIC ION LOSSES NEAR IO'S ORBIT
A. F. Cheng (Dept. of Physics and Astronomy, Rutgers University, Piscataway, N.J. 08854) C. A. Barth, L. J. Lanzerotti, M. T. Pedersen and S. M. Krimigis

We analyze energetic ion phase space density data from the Low Energy Charged Particle (LECP) experiment during the Voyager 1 inbound pass to Jupiter's orbit. We consider the radial transport of energetic particles and the depletion of energetic ion fluxes there. Voyager 1 low energy ion data from the Plasma Science (PLS) experiment and ground-based observations of the Io plasma torus are combined to determine both the absolute normalization and the radial dependence of the radial diffusion coefficient. This same diffusion coefficient is then used to infer the energetic ion loss rates from Voyager 1 LECP ion phase space density data. Energetic ion losses are observed in the region 5.9<L<7.1. The ion loss rates in this region are consistent with plasma wave scattering into the loss cone by diffusion limit. The measured energy dependence of the loss limit is not found, however. There is evidence that the ion loss rate is not spatially uniform even within the main loss region. The total loss rate of satellite is small compared to the observed loss rate, even in the Io sweeping corridor. The charge exchange loss rate is also small compared to the observed loss rate for L<6.5 and becomes important only for L<5.5. Energetic ion distributions are presented, which support the idea that charge exchange losses of energetic ions become important within L~5.8. This interpretation also implies that energetic ions constitute appreciably in LECP ion fluxes in the outer region. (Jupiter magnetosphere, Io, trapped radiation, ion losses)

J. Geophys. Res., Blue, Paper 3A0310

3-D Model of the Lithosphere-Asthenosphere Boundary for a Propagating Rift

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University of Hawaii at Manoa
Honolulu, Hawaii

A first-order approximation of the lithosphere-asthenosphere boundary of a propagating rift model is shown in Figures 1 and 2. (Figure 1 is a reduced version of the cover figure. All bracketed letters in the text correspond to letters in Figure 2.) The propagating rift model explains tectonic patterns of some oceanic regions that have puzzled earth scientists for some time. According to this model, oceanic spreading centers can propagate through older crust, transferring portions of crust from one plate to another.

The two images in Figure 1 form a 3-D stereo pair of the lithosphere-asthenosphere boundary at a propagating rift. To view the 3-D model use a stereoscope on Figure 1; alternatively, stare at Figure 1 or the cover figure and let your eyes soft-focus until a 3-D image appears between the two printed images (believe us, it works). The model is based on the Galapagos propagator at 95.5°W, viewed from above and toward the southeast. The 'V'-shaped wedge of lithosphere between the pseudofaults is formed by extension of the eastern rift toward the viewer. As this rift propagates, spreading stops on the dying western rift, leaving a failed rift. Only two plates are present in the model, and depth to the asthenosphere depends only on age.

The stippled region (A) represents a cross section of the lithosphere and shows how the lithosphere thickens away from the rift. Depth to the ocean bottom (top boundary of A) is calculated by using the equations and assumptions of *Sclater and Francheteau* [1970] for a spreading center that spreads at a rate of 26 mm/yr. Depth is 2.1 km at the spreading center and increases to 3.1 km on the far right. Lithospheric thickness is calculated by using the equation of *Yashi et al.* [1976]

$$L = 7.49(T)^{0.5}$$

where L is the thickness of the lithosphere in kilometers, and T is the age in millions of years. Depth to the lithosphere-asthenosphere boundary (bottom edge of A) is the sum of the ocean depth and lithospheric *thickness*. Thermal and isostatic adjustments that occur at the tip of the propagator and other boundaries have not been incorporated into the model and would tend to smooth the discontinuities and sharp boundaries. Depth is assumed to be a function of age only.

General configuration of the model corresponds to the 95.5°W Galapagos propagator [*Hey et al.*, 1980], except that the initial rifts of this model are offset by a 20-km-long transform fault (B2). Fracture zones (B1, B2–B3) associated with this transform fault terminate at the ends of the pseudofaults (C1, C2). The southern fracture zone (B2–B3) is composed of two sections: the fracture zone that existed when the transform was active (B3) and the original transform fault that was locked in place when rift propagation commenced (B2). As *Hey* [1977] pointed out, and as can be seen clearly here, the sense of vertical offset changes along the southern fracture zone instead of monotonically decreasing, as it does along a normal fracture zone. Intersections of the pseudofaults with the fracture zones mark the locations of lithosphere formed at the initation of propagation. Propagation began at the initial transform fault and has extended the length of the eastern rift (D1) at a constant rate along a different azimuth. Extension of the propagating rift or propagator (D2) proceeds at the expense of the dying rift (D3). As spreading is transferred to the propagator, a portion of the dying rift is frozen into the southern plate and becomes a failed rift (D4). Orientation of the failed rift is controlled by the spreading rate and the extensional growth rate of the propagator. There are only two rigid plates in this model at all times.

Pseudofaults (C1, C2) stand out as large depth discontinuities in the lithosphere-asthenosphere boundary; these discontinuities reflect differences in age between new lithosphere formed at the propagator tip and old lithosphere through which the propagator extends. Vertical offset along the pseudofaults decreases away from the propagator tip because the difference in thickness decreases as both sections of the lithosphere age and because the propagator is extending through progressively older and thicker lithosphere. Note that no horizontal displacement occurs along the pseudofault boundaries, although vertical motion should result from differential aging across the boundaries.

The transform fault (E), which connects the propagator tip to the intersection of the dying and failed rifts, differs in important ways from the classical transform fault of a normal rift system. Material on both sides of the transform fault is formed by the same rift; consequently, there is no sharp age or thermal difference across the boundary. Also, the location of the transform fault is not fixed but moves in the same direction and at the same rate as rift propagation. Its length changes if the propagator is growing at a different azimuth from the dying rift. Note that what would be fracture zones (inactive portions of the transform) in a normal transform fault system are manifested by the northern pseudofault (C1) and by the zone between the southern pseudofault (C2) and the failed rift (D4). All interplate horizontal displacement occurs in the region between the propagator tip and the dying rift and is recognized by the change in azimuth between the dying and failed rifts. *Hey et al.* [1980] suggest that the transform fault of a propagating rift may be a zone of shear deformation rather than a localized fault boundary.

The existence of propagators in several areas has been postulated [*Hey*, 1977; *Hey et al.*, 1980; *Hey and Wilson*, 1980; *Delaney et al.* 1981]. Propagators, and the causes and consequences of propagation, will be one of the most interesting topics in plate tectonics to be studied during this decade.

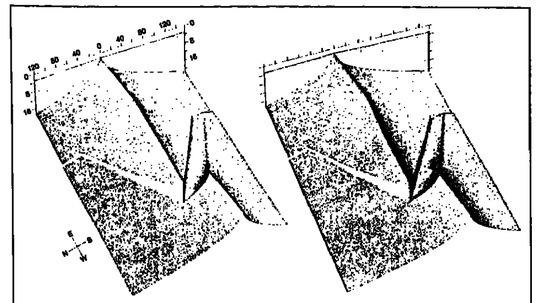

Fig. 1. A 3-D stereo pair of the lithosphere-asthenosphere boundary at a propagating rift. See text for details.

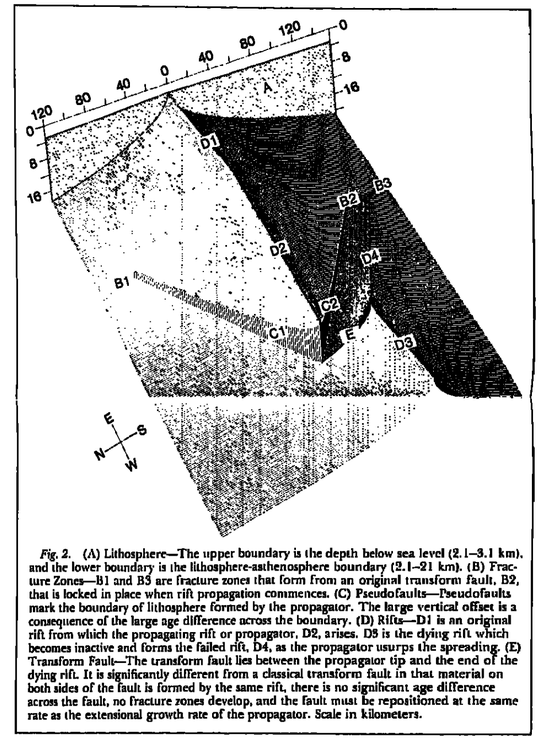

Fig. 2. (A) Lithosphere—The upper boundary is the depth below sea level (2.1–3.1 km), and the lower boundary is the lithosphere-asthenosphere boundary (2.1–21 km). (B) Fracture Zones—B1 and B3 are fracture zones that form from an original transform fault, B2, that is locked in place when rift propagation commences. (C) Pseudofaults—Pseudofaults mark the boundary of lithosphere formed by the propagator. The large vertical offset is a consequence of the large age difference across the boundary. (D) Rifts—D1 is an original rift from which the propagating rift or propagator, D2, arises. D3 is the dying rift which becomes inactive and forms the failed rift, D4, as the propagator usurps the spreading. (E) Transform Fault—The transform fault lies between the propagator tip and the end of the dying rift. It is significantly different from a classical transform fault in that material on both sides of the fault is formed by the same rift, there is no significant age difference across the fault, no fracture zones develop, and the fault must be repositioned at the same rate as the extensional growth rate of the propagator. Scale in kilometers.

Acknowledgments

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References

Delaney, J. R., H. P. Johnson, and J. L. Karsten, The Juan de Fuca Ridge—Hot spot—Propagating rift system: New tectonic, geochemical and magnetic data, *J. Geophys. Res., 86* (B12), 11,747–11,750, 1981.

Hey, R. N., A new class of 'pseudofaults' and their bearing on plate tectonics: A propagating rift model, *Earth Planet. Sci. Lett., 37*, 321–325, 1977.

Hey, R. N., and D. S. Wilson, Propagating rifts—The motion picture, *Eos Trans. AGU, 61*, 1104–1105, 1980.

Hey, R. N., F. K. Duennebier, and W. J. Morgan, Propagating rifts on midocean ridges, *J. Geophys. Res., 85*, 3647–3658, 1980.

Sclater, J. G., and J. Francheteau, The implications of terrestrial heat flow observations on current tectonic and geochemical models of the crust and upper mantle of the earth, *R. Astron. Soc., Geophys. J., 20*, 509–542, 1970.

Yoshi, T., Y. Kono, and K. Ito, Thickening of the oceanic lithosphere. In *The Geophysics of the Pacific Ocean Basin and Its Margin, Geophys. Monogr. Ser.*, vol. 19, edited by G. H. Sutton, M. H. Manghnani, and R. Moberly, pp. 423–430, AGU, Washington, D.C., 1976.

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Phillip D. Milholland *received his B.S. degree from the University of Washington in 1975 and his M.S. from the University of Hawaii in 1978. His Ph.D. work is on the seismicity of the 95.5°W Galapagos propagating rift.*

Frederick K. Duennebier *received his B.S. from Trinity College, Hartford, Connecticut, in 1967; he received his M.S. (1969) and Ph.D. (1972) from the University of Hawaii. He worked on the Apollo Lunar Seismic Experiment and Viking Martian Seismic Experiments until 1975, when a lack of data drove him to marine seismology and tectonics.*

News

New NAE Head

Robert M. White, president of the University Corporation for Atmospheric Research (UCAR) and an AGU Fellow, has been elected president of the National Academy of Engineering (NAE). White's 4-year term begins July 1. He succeeds Courtland D. Perkins, who has been NAE president since 1975.

As NAE president, White will serve as vice chairman of the National Research Council (NRC). Frank Press, president of the National Academy of Sciences and former AGU president, is NRC chairman.

A search committee has been established at UCAR to find White's successor. For additional information, write to Thomas Donahue, Chairman, Search Committee, University Corporation for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307. May 6 is the deadline for applications. UCAR, a consortium of 50 universities with doctoral programs in the atmospheric sciences or closely related fields, manages the National Center for Atmospheric Research under contract with the National Science Foundation. UCAR also carries on other activities to promote atmospheric science in the public interest.

New Weather Index

Scientists at the National Oceanic and Atmospheric Administration (NOAA) and the University of Delaware have refined the wind-chill factor, a common measurement of weather discomfort, into a new misery register called the weather stress index. In addition to the mix of temperature and wind speed data used to calculate wind chill, the recipe for the index adds two new ingredients—humidity and a dash of benchmark statistics—to estimate human reaction to weather conditions. NOAA says that the weather stress index estimates human reaction to weather conditions and that the reaction depends on variations from the 'normal' conditions in the locality involved.

Discomfort criteria for New Orleans, La., and Bismarck, N.D., for example, differ drastically. According to NOAA, when it's the middle of winter and it's -10°C with a relative humidity of 80% and 24 km/h winds, persons in New Orleans would be highly stressed while those in Bismarck wouldn't bat an eye.

NOAA plans to generate daily, weekly, and monthly weather-stress maps of the United States.

TV Special on Geophysics

Earthquake prediction, earthquake preparation in California and Japan, the theory of plate tectonics, and the causes and effects of earthquakes and volcanoes will be the subjects of a National Geographic television special scheduled to air on public television on April 6.

Among the locations visited by 'Born of Fire' are Iceland, where magma oozes to the surface on the remote island of Heimaey, illustrating the moving crustal plates; the Republic of Djibouti in east Africa, where some scientists believe a new ocean will form as three crustal plates spread apart; and the island of Santorini in the Aegean Sea, where a series of earthquakes and volcanic eruptions some 3,500 years ago destroyed two-thirds of the island and obliterated the city of Akrotiri.

The special, featuring geologist Robert Ballard of the Woods Hole Oceanographic Institution, is produced by the National Geographic Society and WQED of Pittsburgh with a continuing grant from Gulf Oil Corporation. Check local television listings for time and station.

Geophysical Events

This is a summary of *SEAN Bulletin*, 8(2), February 28, 1983, a publication of the Smithsonian Institution. The complete Long Valley, Colima, and Langila reports are included; the earthquake report is an excerpt.

The complete bulletin is available in the microfiche edition of *Eos* as a microfiche supplement or as a paper reprint. Subscriptions to *SEAN Bulletin* are also available. For the microfiche, order document E83–003 at $2.50 from AGU Fulfillment, 2000 Florida Avenue, N.W., Washington, DC 20009. For reprints, order *SEAN Bulletin* (give volume and issue numbers and issue date) through AGU Separates; $5.50 for one copy of each issue number for those who do not have a deposit account; $2 for those who do; additional copies of each issue number are $1.00. For a subscription, order *SEAN Bulletin* from AGU Fulfillment. The price is $18.00 for 12 monthly issues mailed to a United States address; $28.00 (U.S.) if mailed elsewhere. Order must be prepaid.

Volcanic Events

Kilauea (Hawaii): Renewed fountaining and lava flow production on E Rift.

Mt. St. Helens (Washington): Spine added to February lobe, then extrusion stops; seismicity suggests renewed extrusion by late March.

Long Valley (California): Seismicity remains elevated, but no new swarms.

El Chichón (México): Little change to N hemisphere cloud; tiny aerosols recondense above 30 km; unusual sunrises and sunsets.

Colima (México): Lava extrusion ended June 1982 but plume emission continues.

Ol Doinyo Lengai (Tanzania): Tephra emission continues; lava flow.

Langila (New Britain): Explosions build to 6-day strombolian-vulcanian event.

Manam (Bismarck Sea): Rumblings, night glow, increased vapor emissions.

Ruapehu (New Zealand): Possibly pre-eruptive changes continue.

Sakurajima (Japan): Increased explosive activity; rain-caused debris flows.

Long Valley Caldera, California, USA (37.68°N, 118.86°W). As of early March, an average of 10–30 events per day of magnitude ≥1 continued to occur in the southern part of the caldera in the epicentral area of the major January earthquake swarm (see *SEAN Bulletin* 7 (12) and 8 (1)). For several months prior to the January swarm the background level of seismicity in the caldera had averaged 8–10 earthquakes of magnitude ≥1 per day. Few larger events were recorded in February, but 5 shocks with magnitudes >3 occurred February 18–19 and a magnitude 4 earthquake was recorded February 24 in the January epicentral region. Heavy snows have severely limited deformation monitoring, but available data suggest that no major changes have occurred since January.

Information Contact: David Hill, Mail Stop 77, U.S. Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025 USA.

Colima Volcano, SW Mexico (19.42°N, 103.72°W). A French team reached the northern rim of the summit cone in early December. Storm damage to trails prevented them from reaching the southern side of the cone, so they were unable to see the southern-flank lava flow produced by the eruption that began in December 1981 (see *SEAN Bulletin 7* (1–3)). Only fumarolic activity was observed in the western part of the crater and on the northern flank. Gas of essentially atmospheric composition was emitted at 500°C from the northeastern part of the cone and from a vent that had recently extruded a lava flow. Rockfalls occurred several times per day from the front of this flow and it may still have been advancing very slowly.

James Luhr and others visited Colima in mid-January and again in early February. The southern flank lava flow appeared to have advanced very little since last observed by Luhr in March 1982. Residents of the area reported that incandescence had ended in June 1982. Plume emission continued in early 1983 at about the same intensity as a year earlier, but there were no episodic increases in intensity of plume emission as there had been in early 1982.

Information Contact: Jean Louis Cheminée, Laboratoire de Géologie, Ecole Normale Supérieure, 46 Rue d'Ulm, 75230 Paris Cedex 05, France; James Luhr, Department of Geology and Geophysics, University of California, Berkeley, CA 94720 USA.

Langila Volcano, New Britain Island, Papua New Guinea (5.53°S, 148.42°E). This report is from P. Lowenstein:

"The increased vulcanian activity of crater 2 in January [see last month's *SEAN Bulletin*] culminated in a rise of the magma column, with an eruptive phase maximum February 11–16. The February 3–11 buildup of the eruption consisted of approximately hour-long periods of loud, rumbling noises, with deep explosion sounds at 8–50 s intervals. Several times per day at irregular intervals individual explosions produced black, ash-laden columns that rose as much as 3–4 km before being dissipated by the northwesterly winds. Night glow, observed February 3, became more intense during this period. Low strombolian fountaining was visible February 3–5 and 9.

"During the 6 days of maximum activity, crater 2 simultaneously displayed continuous strombolian fountaining to 100 m and intermittent powerful vulcanian explosions. Most of the vulcanian explosions were laterally directed, while the continuous moderate vapour emissions and the strombolian fountaining were central and vertical, leading to the conclusion that crater 2 may contain two more or less independent vents.

"Seismic activity consisted of a sub-continuous background of harmonic tremor and strombolian B-type earthquakes. Each individual vulcanian eruption produced large-amplitude, low-period explosion events. The most powerful of these explosions occurred February 12–13 and 15 at the rate of 2–5 per hour.

"Activity diminished rapidly on February 16 and stopped completely on February 17, but harmonic tremor continued. Weak glow was visible on February 19, and vulcanian explosions occurred on February 19 and 23.

"During the eruption, crater 3 (a separate composite cone 300 m west of crater 2) released only weak, white vapours. However, the volume of emission increased to moderate or large during the first 10 days of February, the time of the activity buildup at crater 2."

Information Contact: P. Lowenstein, Senior Government Volcanologist, Rabaul Volcano Observatory, P.O. Box 386, Rabaul, Papua New Guinea.

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Geology of the Central Transantarctic Mountains

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Meteorite fall: Tennessee, USA, January 28; additional fireball observation.

Fireballs: North Atlantic; Australia (2); Bay of Bengal; Egypt; England; Germany; Italy; Oregon and Washington, USA.

Earthquakes

Date	Time (UT)	Magnitude	Latitude
Feb. 13	0140	6.2 M_s	39.91°N
Feb. 13	0636	5.6 m_b	13.84°N
Feb. 14	0320	6.3 M_s*	54.91°N
Feb. 25	1822	4.8 m_b	42.10°N
Feb. 27	1214	5.8 m_b	35.96°N

Longitude	Depth of Focus	Region
75.10°E	shallow	Southwestern China
144.98°E	169 km	Mariana Islands
159.19°W	shallow	Alaska peninsula
21.51°E	10 km	Yugoslavia
135.85°E	83 km	Japan

*Berkeley measurement 6.5 M_s

Information Contact: National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal Center, Box 25046, Denver, CO 80225 USA.

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Cover. The two images form a three-dimensional stereo pair of the lithosphere/asthenosphere boundary for a propagating rift. Viewing this boundary provides insight into the 3-D structure of the rift system. The propagating rift theory offers explanations for a wide range of geological questions, such as the reorientation of oceanic rifts or spreading centers, origin of transform faults; origin of continental rifting, generation of high magnetic anomaly zones, and formation of complex magnetic anomaly patterns in areas such as the Juan de Fuca plate. Additional discussion and a description of how to view the model in 3-D is included in the accompanying article. (Figure courtesy of Phillip D. Milholland and Frederick K. Duennebier.)

Books

Advanced Techniques for Clay Mineral Analysis

Dev. in Sedimentol. 34, J. J. Fripiat (Ed.), Elsevier, New York, vi + 235 pp., 1982, $46.50

Reviewed by Herman E. Roberson

Advanced Techniques for Clay Mineral Analysis is a collection of review articles dealing with nine analytical techniques: thermoanalytical methods, high resolution electron-microscopy studies, neutron scattering techniques, nuclear magnetic resonance, Mossbauer spectroscopy, electron spin resonance, ultraviolet and visible light spectroscopy, far infrared spectroscopy, and electron spectroscopy for chemical analysis (ESCA).

Each chapter includes some discussion of theory as it relates to a particular technique, but the main emphasis according to J. J. Fripiat, the editor, was to be directed toward summarizing recent developments of clay research applications. In fact there is an unevenness in this regard. Some authors (e.g., P. L. Hall on neutron scattering and J. P. Eberhart on high resolution electron-microscopy) have devoted a significant proportion of their articles to theoretical discussion, while other authors (T. J. Pinnavaia on electron spin resonance studies of clay minerals and R. D. Mackenzie on thermoanalytical methods) have no general discussion of theory.

Three areas of study reviewed have been extensively developed by chemists but have only recently received attention from clay researchers: Mossbauer spectroscopy, nuclear magnetic resonance (NMR), and electron spin resonance. Applications of Mossbauer spectroscopy in the study of clays are fairly extensive; as a result the author, B. A. Goodman, makes no attempt to present a comprehensive review. However, these topics which were selected (e.g., identification of oxidation states of iron and identification of iron-containing mineral phases at levels below their limits of detection by other more conventional techniques) will be of interest to many clay researchers. The review of NMR applied to water–clay systems is comprehensive; the clay researcher attempting to get an overview in this research area may want to start here. Electron spin resonance applications which are discussed include studies of the orientation of hydrated metal ions on basal clay surfaces, mobility of interlayer ions, and a number of interlamellar metal complexes.

In his review of high resolution electron-microscopy application, J. P. Eberhart points out that this technique has already been applied with success in the study of several layer silicates (primarily well-crystallized micas). The technique holds promise for the clay mineralogist who is willing to devote himself to gaining a thorough knowledge of the imaging process required for analysis.

ESCA, a relatively new technique, is one that holds great promise for clay research. The technique, because of its high selectivity for the surface of the material being analyzed, has a range of applications that includes adsorption studies as well as studies related to the growth and alteration of clay minerals.

In general the articles are well written and achieve the primary goal: to acquaint the reader with some important analytical techniques which have been recently applied in studies of clay minerals. However, it should be pointed out that excellent review articles on many of the topics covered in this book have been published recently. This, along with the price ($46.50), may curtail sales.

Herman E. Roberson is with the Department of Geological Sciences, State University of New York at Binghamton, Binghamton, New York.

Climatic Geomorphology

J. Büdel (Engl. Transl.), Princeton University Press, Princeton, N.J., xix + 443 pp., 1982, hardbound, $50; cloth, $18.50.

Reviewed by A. T. Grove

Although this book opens with a map of the world showing the continents divided into 10 morphoclimatic regions, this is not simply a text book on geomorphology organized climatically. Rather it is a dissertation which at-

Books (*cont. on p. 124*)

1983 ANNALES GEOPHYSICAE New

Editor-in-Chief: Stephan Mueller

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1983, 288 pp., 8¼" × 11¼", $72.50
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Books *(cont. from p. 123)*

temps to provide an explanation for the morphology of the earth. L. C. King had the same ambition, as had W. Penck and, more diffidently, W. M. Davis. One may continue to be impressed by the clarity and visual attractiveness of Davis's exposition, though dissatisfied with the integration of its elements; W. Penck's ideas, notably his mechanism for piedmont stairway development, are more difficult to appreciate; King's explanation of upland plains in terms of scarp retreat over immense distances as the result of uplift generated by the disruption of the continents fails to convince most geomorphologists.

A basic problem to be solved is the means by which the land surface is lowered to produce extensive plains developed on solid rock, which may then be dissected, with the preservation of extensive fragments apparently little modified.

The German text from which this book is derived appeared in 1977. Büdel was a pupil of Bruckner and Albert Penck. A splendid picture of both of them precedes the contents, one holding an umbrella, the other a hammer, both with pocket watches and seated on a pile of logs. These details are possibly significant in the light of what follows. Of the references, which number over 850, nearly three quarters are in German; 41 are to Büdel himself, the earliest dating from 1933; many are from German university journals with papers by Bremer, Louis, Mensching, and Troll particularly well represented. H. F. Garner's 'The Origin of Landscapes,' probably the closest approach in English to Büdel's book, is unfortunately attributed first to Garner and then to Gardner.

The gist of Büdel's argument is that landscapes can be explained in terms of the following sequence of events and shifts in climatic zonation.

(1) In Tertiary times, seasonally wet warm climates extended from the equator to the poles and etchplains were created worldwide by the mechanism of double planation. This is assumed to result from the fact that chemical weathering at the base of the weathered layer is more intense than anywhere else in the world because the soil fauna and flora supply large quantities of carbonic acid, and the water is renewed every rainy season. Along joint planes decomposition takes place particularly deeply giving great thicknesses of grus with core stones. Rock masses protruding above the soil are regarded as exempt from such weathering and between these shield inselbergs, 'Surface wash in the shifting network of tiny rainy season rivulets and wash channels' is regarded as 'the decisive process causing planation' (p. 146).

(2) By the Late Pliocene, climatic zones were becoming differentiated with the development of polar icecaps, and etchplain development was increasingly confined to middle and low latitudes. The main areas of today's rivers became fixed at medium elevations in Central Europe' (p. 299), and high valley systems formed in the Alps give the trough shoulders of glaciated valleys. Pediment formation began as essentially a trimming process mainly confined to deserts with cold winters and the production of abundant frost debris.

(3) The Pleistocene is viewed as involving in its last quarter a fourfold expansion and retreat of icecaps. Fundamental processes in middle latitudes resulted in the rapid incision of box valleys 100 to 300 m deep. Largely because of the disruptive effects of 'ice and ground ice immediately below the active layer, which 'promotes both vertical and lateral erosion and is the driving force causing the periglacial frost debris zone to be morphodynamically the zone of excessive valley cutting' (p. 105). At the same time, insolbergs were removed by frost action. In warm deserts, soil sheets were replaced by rubble sheets, and basal surfaces of etchplains were extensively revealed by stripping away of the weathered layer, especially along lines corresponding with the direction of the trade winds.

(4) The Holocene period has been so short that only a few percent of the relief can be ascribed to it. This is particularly the case in the middle latitudes, best known to most geomorphologists, where processes are peculiarly weak except where they have been artificially accelerated by deforestation.

This scheme is exemplified by various regional examples taken mainly from southern Germany and southeast Europe.

Büdel's exposition can be criticized on various grounds. Too often he asserts without presenting evidence. More support is needed, for instance, for the claim on p. 124 that the intense chemical weathering taking place in the peritropical zone 'exceeds all chemical weathering found in any other climate.' It is really self-evident, therefore, that these rivers of the peritropical zone 'must carry enormous amounts of dissolved matter, for it is in tropical areas quite impossible to salvage' (p. 134). Throughout, there is too little attempt to provide chronological control through the use of existing isotopic dates of intrusive and extrusive rocks. Nevertheless one can welcome the forthright emphasis on the reliance of present-day forms on processes no longer operating on them and the acute comments based on field observation. I particularly appreciated a section on the burial of Olympia (pp. 338–340).

Perhaps this volume, by reintroducing British and American geomorphologists to a tradition they abandoned a generation ago, will lead some of them to attempt a reassessment of the morphology of the earth. While it could well be comparable to that of Büdel's, such a reassessment should take fuller account of the advances made over the last two decades in knowledge of plate tectonics, the Cenozoic climatic record, and geomorphic processes, and it should not neglect the enhanced appreciation remote sensing has given us of the form of the surface and what lies beneath it.

A. T. Grove is the director of the African Studies Center, University of Cambridge, Cambridge, United Kingdom

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Applications are invited for appointment to the above post with effect from 1 February 1984.

The University wishes to appoint a scientist with an established research record to take responsibility for the further development of research and teaching in this recently created department. Candidates currently occupying either academic or non-academic positions should have a wide knowledge of modern instrumental analysis and this requirement will be of prime importance in making the selection for the post.

Appointment, depending on qualifications and experience, will be made in the salary range R23 109 to R30 255 per annum, to which is added an annual service bonus of nearly one month's salary.

Applicants should submit a full resumé and the names and addresses of three referees whom the University may approach.

Further information should be obtained from the Registrar (Attention: Appointments Office), University of Cape Town, Private Bag, Rondebosch, 7700, South Africa, by whom applications (quoting ref. no. BM/332) must be received not later than 24 June 1983.

UCT is an equal opportunity employer.

Faculty Position/Physical Oceanography, University of Maryland Center for Environmental and Estuarine Studies (UMCEES). The Horn Point Environmental Laboratories of UMCEES invite applications for a tenure-track (rank open) position for a physical oceanographer. The physical oceanographic program is young and developing, so that candidates with a wide range of research interests will be considered. Opportunities exist for oceanographers with experimental, theoretical, or numerical modeling skills. In addition, the strong chemical and biological programs provide opportunities for interdisciplinary research. Although some preference will be given to applicants with interests in continental shelf and estuarine circulation processes, the primary criterion for selection of the successful candidate is the ability to develop a strong research program. The closing date for applications is May 16, 1983. Applications and a list of references should be sent to:

Dr. William C. Boicourt
Chairman, Search Committee
University of Maryland
Center for Environmental and
Estuarine Studies
Horn Point Environmental Laboratories
P. O. Box 775
Cambridge, Maryland 21613.

The University of Maryland is an Affirmative Action/Equal Opportunity Employer.

Hydrogeologist. Applications are invited for a hydrogeologist—engineering geology position starting in January 1984. Rank and salary are dependent on qualifications and experience. Ph.D. degree and registration as a professional engineer desirable.

Responsibilities will include undergraduate and graduate teaching and graduate research in hydrogeology and engineering geology. Applicants should have experience in field groundwater investigations of regional site specific nature/groundwater resource analyses/waste disposal/groundwater containment studies. Experience in applying remote sensing to hydrogeology and engineering studies would be helpful.

Send resume and names of three references to J. J. Finney, Head, Geology Department; Colorado School of Mines, Golden, Colorado 80401. Applications will be accepted until September 15, 1983. The Colorado School of Mines is an affirmative action/equal opportunity employer.

UNIVERSITY OF CAPE TOWN

Research Officer: Economic Geology

Applications are invited for the above vacant post in the Department of Geology. The initial appointment will be for a three-year period.

The successful applicant will conduct research primarily in the field of Economic Geology and will also do some teaching within the Department. He or she will work closely with Professor I. Minter in establishing a research programme in Economic Geology at the University of Cape Town.

Applicants should have a Ph D degree or equivalent research experience. Appointment will be made according to qualifications and experience in the salary range R12 657 to R22 175 per annum. Staff benefits include an annual bonus of nearly one month's salary, pension, medical aid and a housing subsidy subject to State regulations.

Applicants should submit a curriculum vitae stating research interests, age, present salary, experience and qualifications, the date duty could be assumed and the names of three referees.

Further information is obtainable from Professor A M Reid, Department of Geology, University of Cape Town, Private Bag, Rondebosch, 7700, South Africa, by whom applications should be received by 31 May 1983.

The University's policy is not to discriminate on the grounds of sex race or religion.

Engineering Analysis of Fluvial Systems

August 1-4, 1983
Copper Mountain Resort, Colorado

State-of-the-art design techniques oriented to solving practical engineering problems associated with watersheds and rivers are presented in this four day short course. The course is designed to enhance the participants' insight into physical processes and the associated mathematical modeling techniques. Design applications are illustrated with numerous case studies. The recently published hardbound text *Engineering Analysis of Fluvial Systems* will be provided to each participant.

Lecturers: D.B. Simons, R.M. Li, and P.F. Lagasse

Registration fee: $450 U.S. Dollars

Contact: Dr. Peter F. Lagasse
Simons, Li & Associates, Inc.
P.O. Box 1816
Fort Collins, CO 80522
(303) 223-4100

STUDENT OPPORTUNITIES

IBM Environmental Engineering Graduate Fellowship. Colorado State University invites applications from students interested in a Ph.D. engineering program with specialties in water quality hydrology and water quality monitoring. The fellowship provides a $1,000/month stipend, all tuition and fees, books, research expenditures and travel funds. For further information or application, please write.

Dr. Robert C. Ward
Department of Agricultural and
Chemical Engineering
Colorado State University
Fort Collins, CO 80523

Colorado State University is an equal opportunity employer.

Geochemist. A career position is available in the Earth Sciences Department at Lawrence Livermore National Laboratory, Livermore, California, for a Geochemist, or a person with related training or experience, to provide geochemical modeling support to the evaluation of repository sites for the disposal of nuclear waste.

The work involves developing and extending existing geochemical computer codes, updating thermodynamic data bases and experimental work in support of and to validate the geochemical models. Requires knowledge of FORTRAN, an advanced degree or equivalent in Geochemistry, Physical Chemistry or Inorganic Chemistry, and experience in developing and using computer codes to solve geochemical problems.

Send detailed resume with full employment history and objectives to Art Wong, Professional Employment Division, LAWRENCE LIVERMORE NATIONAL LABORATORY, P. O. Box 5510, KES-033, Livermore, CA 94550. U.S. citizenship is required.

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Mineralogy and Petroleum Geology/Eastern Washington University. The Department of Geology is seeking applicants for a faculty position in mineralogy and one in petroleum geology. Doctoral degree required. Mineralogist to teach mineralogy and X-ray diffraction/fluorescence. Petroleum geologist with industrial experience to teach petroleum geology and some area of soft rock geology. Both positions require teaching undergraduate/graduate courses in area of specialization plus introductory geology. Development of strong research program expected. Positions start September 1, 1983. Evaluation of applications begins April 30, 1983. Send letter of application, vita, and 4 letters of recommendation to Dr. Eugene Kiver, Search Committee, Department of Geology, Eastern Washington University, Cheney, Washington 99004.
AA/EOE.

Research Position/Space Physics. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicant(s) will play key role(s) in the development of theoretical three-dimensional models of the Earth's electromagnetic field. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere-ionosphere coupling, ionosphere-atmosphere coupling, atmospheric electricity. Experience and/or interest in numerical modeling is an important consideration.

Title and salary level commensurate with experience, ranging from one-year Research Associateship renewable in subsequent years depending on performance to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Department, Rice University, Houston, TX 77251.

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Staff Scientists/Systems Analysts. Research and Data Systems, Inc. has openings available for Staff Scientists, Systems Analysts and Programmer/Analysts to work in areas involved in the processing and application of data from satellite based remote sensing systems. Particular needs involve the analysis and processing of Earth Radiation Budget, Microwave, AVHRR and LANDSAT data. Needs also exist in the areas of interactive image graphics, software engineering, realtime processing and satellite data communications. Successful candidates will have an advanced degree in meteorology, physics, engineering, mathematics, or computer science. Hardware background should include IBM 370/168, CYBER or HP-1000 equipment. Send resume in confidence to:

Research and Data Systems, Inc.
10300 Greenbelt Road, Suite 206
Lanham, Maryland 20706
Telephone: (301) 390-6100.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

May 9–13, 1983. "Planning, Design, and Operation of Real-Time Data Monitoring Systems and Applications." $750.00. Topics include remote-site sensors and telemetry equipment, communications systems options (satellite, radio line-of-sight, telephone, etc.), data collection platforms, computer systems software, data base design and management, applications studies that include flood control, irrigation, hydropower production, hydrological and meteorological data collection, water quality, air pollution, acid rain, groundwater levels and quality, etc., economics of real-time data collection, use of radar information, current status of hardware, computer graphics and computer imagery for remote sensing. For additional information, contact Dr. Raul S. McQuivey, Sutron Corporation, 11180 Main Street, Fairfax, Virginia (703) 591-8010.

RESEARCH POSITION IN GEODYNAMICS-ASTROMETRY

At the Lunar Satellite Ranging Facility Haleakala Observatory, Maui, Hawaii

The University of Hawaii's Institute for Astronomy has an immediate opening for a Researcher.

The selected applicant will work closely with the Observatory Project Manager to ensure an effective program of ranging on artificial satellites and the moon; will also conduct a research program in an area of interest to the facility; and will be a resident on the island of Maui. Minimum Qualifications: Ph.D. in Geosciences, Astronomy, or Physics and a proven record as a researcher as demonstrated by a list of publications and recommendations of peers.

The position is full-time, federally funded, subject to annual contract renewal, and continuation dependent upon availability of funds. Salary will be commensurate with qualifications and experience.

Interested individuals should send a bio-bibliographical summary together with the names of two or three people who have knowledge of the applicant's professional abilities to: **Ms. Carol Yoshida, Personnel Officer, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, Hawaii 96822.** Further details can be obtained from Dr. John T. Jefferies, Director at (808) 948-8566. Applications should be postmarked no later than April 29, 1983.

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Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation; the letter A denotes the Atmospheric Sciences section, which was formerly the Meteorology section.

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Expressly for women intending to make a career in the atmospheric sciences. This monetary assistance, provided through a gift from June Bacon-Bercey, a noted meteorologist, will be given to a woman who shows academic achievement and promise. To qualify, candidates must be one of the following:

- a first-year graduate student in an advanced degree program in atmospheric sciences;
- an undergraduate in a bachelor's degree program in atmospheric sciences who has been accepted for graduate study;
- a student at a 2-year institution offering at least six semester hours of atmospheric sciences, who has been accepted for a bachelor's degree program, and who has completed all of the courses in atmospheric science offered at the 2-year institution.

Awardee selection will be made by the AGU Subcommittee on Women in Geophysics in consultation with the AGU Atmospheric Sciences Section.

For application forms contact:
American Geophysical Union
Member Programs Division
2000 Florida Avenue, N.W.
Washington, D.C. 20009
462-6903
800-424-2488 outside the Washington, D.C. area

Application Deadline
May 1, 1983

Meetings

Announcements

Call for Papers: Chapman Conference on Magnetic Reconnection

A Chapman Conference on 'Magnetic Reconnection' will be held at the Los Alamos National Laboratory, Los Alamos, New Mexico, October 3–7, 1983. Since its conception over three decades ago as a possible solar flare mechanism, magnetic reconnection has become a matter of substantial interest and probable importance not only for flares but also for other domains of plasma physics, including planetary and stellar magnetospheres and laboratory fusion research. The main emphasis of this meeting will be on magnetic reconnection in the earth's magnetosphere, but the perceived role of reconnection in other cosmic objects and in laboratory plasmas will also be treated to provide a full picture of the present understanding of this process.

Specific areas of discussion will include the following topics: theories of reconnection and its anticipated signatures, reconnection at the earth's magnetopause, reconnection in the earth's magnetotail, reconnection in astronomical objects, reconnection in laboratory plasmas, computer modeling of reconnection, and directions for future research.

The 4½-day conference will include morning sessions plus a mix of afternoon and evening sessions that will leave sufficient time for discussion. Poster papers will be encouraged and will be previewed and displayed so as to optimize their communication to Conference participants. Arrangements will be made to provide to attendees during the meeting a volume of extended summaries of the papers and to publish conference papers in book form afterward.

All who are interested in attending and in receiving later information circulars should write to Magnetic Reconnection Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009 (telephone, toll free: 800-424-2488 or, in the D.C. area, 462-6903).

To submit an abstract, follow the abstract format published in *Eos*, November 30, 1982, and January 18, 1983. There will be no abstract charge. All abstracts should be sent to Magnetic Reconnection Meeting, AGU, at the address in the previous paragraph.

ABSTRACTS DEADLINE
JULY 1, 1983

Program Committee: E. W. Hones, Jr., Los Alamos National Laboratory; V. M. Vasyliunas, Max-Planck-Institute for Aeronomy, Katlenburg-Lindau, FRG; F. Coroniti, Department of Physics, UCLA; D. N. Baker, Los Alamos National Laboratory; D. H. Fairfield, NASA Goddard Space Flight Center; A. Nishida, Institute of Space and Astronautical Science, Tokyo; J. Brackbill, Los Alamos National Laboratory; C. T. Russell, Institute of Geophysics and Planetary Physics, UCLA; B. U. Ö. Sonnerup, Radiophysics Laboratory, Dartmouth College.

Student Travel: Limited funding is available to support student travel expenses to the conference. To apply, write to AGU giving your educational background, your reasons for wanting to attend the conference, and your research interests. The awardees will be selected by AGU in conjunction with the program committee. Deadline for travel applications is July 1, 1983.

Hydrology Days Update

The AGU Front Range Branch Hydrology Days symposium will be held at the Colorado State University in Fort Collins, April 19–21. The 28 papers to be presented will cover such topics as flow resistance of boulder-bed streams; snowmelt runoff simulation using the Martinec-Rango model; long-term models of phosphorous in completely mixed lakes; multilayered aquifer modeling; the rainfall-runoff process from a geomorphic-hydraulic perspective; infiltration, soil moisture redistribution, soil evaporation, and aquifer recharge in the HEC 1 (Hydrological Engineering Center) model; approaches for estimating regional snowpack equivalent; and variability of bed material transport and channel hydraulics with high washload concentrations.

The AGU Front Range Branch Hydrology Days (*Eos*, November 2, 1982, p. 838, and July 27, 1982, p. 589) is dedicated to Robert E. Glover in recognition of his contributions to hydrology. Glover, on the faculty of Colorado State University from 1956 to 1963, is currently a faculty affiliate.

For more information, a complete program, and registration materials, contact H. J. Morel-Seytoux, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523 (telephone: 303-491-5448).

Geophysical Year

New Listings

The complete Geophysical Year last appeared in the December 21, 1982, *Eos*.

A boldface meeting title indicates sponsorship or cosponsorship by AGU.

August 29-September 8, 1983 4th International Symposium on Water–Rock Interaction, MISASA, Japan. (Professor H. Sakai, Secretary-General, WRI-4, Institute for Thermal Spring Research, Okayama University, MISASA, Tottori-Ken 682–02, Japan.)

September 30-October 1, 1983 Pacific Northwest Regional Meeting, Bellingham, Wash. (Myrl E. Beck, Jr., PNAGU, Department of Geology, Western Washington State College, Bellingham, WA 98225.)

Water Resources Monograph 7

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Aeronomy

0410 Absorption and Scattering of Radiation
OZONE DENSITIES IN THE LOWER MESOSPHERE MEASURED BY A LIMB SCANNING ULTRAVIOLET SPECTROMETER
D.W. Rusch (Laboratory for Atmospheric and Space Physics and Department of Astro-Geophysics, University of Colorado, Boulder, CO 80309), G.H. Mount, C.A. Barth, G.J. Rottman, R.J. Thomas, G.E. Thomas, R.W. Sanders, G.H. Lawrence and R.S. Eckman.

The ozone content of the earth's atmosphere between 1 mb and 0.06 mb has been measured as a function of latitude and season by an ultraviolet spectrometer on the Solar Mesosphere Explorer spacecraft. The ozone mixing ratio is found to be highly variable in time and space during the winter of 1982 with maxima occuring in the winter hemisphere during January and February at all pressure levels. The latitude gradients near spring equinox are relatively small. A relative maximum occurs at latitudes between 15 and 30°S in January and February.
Geophys. Res. Lett., Paper 3L0318

0440 Convection, diffusion, mixing, turbulence, and fallout
EDDY DIFFUSION COEFFICIENTS IN THE LOWER THERMOSPHERE
V. W. J. H. Kirchhoff (Instituto de Pesquisas Espaciais -INPE, Conselho Nacional de Desenvolvimento Cientifico e Tecnológico - CNPq, 12200 São José dos Campos, São Paulo, Brasil) and B. R. Clemesha

The seasonal variation of the eddy diffusion coefficient is deduced for a height of 94 km at 23°S based on two independent methods of analysis. One of these, already used in the past, is related to indirect measurements of atomic oxygen and the other one is a new method related to measurements of the density of upper atmospheric sodium. The results are mutually consistent giving a maximum eddy diffusion coefficient during summer. (Eddy diffusion, Eddy diffusion coefficients, atmospheric sodium).
J. Geophys. Res., Blue, Paper 3A0410

Electromagnetics

0705 Antennas
RESONANCE CONES IN NON-MAXWELLIAN PLASMAS-2
M. Thiemann (Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah 84322), and N. Singh

Resonance cones in a hot magnetized non-Maxwellian plasma are investigated. The non-Maxwellian nature of the plasma is described by two electron populations: a background population and an electron beam with variable beam parameters. It is shown that the Cerenkov cone occurs at angles much smaller than the group-velocity cone angle θ_c for the lower branch of the oblique resonance cone irrespective of the magnitude of the biasing magnetic field. When the beam velocity is sufficiently large with respect to the thermal velocity of the background electrons, a characteristic wave pattern appears outside the resonance cones. It is shown that this pattern occurs because of a propagating wave for $\theta_c \le \theta \le 180° - \theta_c$. When the beam density is low ($n_b < 1\%$), the upstream resonance cone structure remains nearly unmodified, and it can be used for plasma diagnostics to deduce electron temperature and density using theoretical results based on a Maxwellian plasma.
Rad. Sci., Paper 3S0296

Geochemistry

1410 Chemistry of the Atmosphere
KINETICS AND MECHANISM OF THE OXIDATION OF S(IV) BY OZONE IN AQUEOUS SOLUTION WITH PARTICULAR REFERENCE TO SO_2 CONVERSION IN NONURBAN TROPOSPHERIC CLOUDS
H. G. Maahs (NASA Langley Research Center, Hampton, Virginia, 23665)

The kinetics of S(IV) oxidation by ozone in aqueous solution have been studied at 10°C and 25°C in the pH range 3.0 to 6.2 using stopped-flow spectrophotometry. The rate data are empirically correlated by

$$r = (k_1 + k_2\ 10^{pH})[S(IV)][O_3]$$

with $k_1 = 4.39 \times 10^{11}\ e^{-4131/T}\ (\pm 3 \times 10^{4})\ M^{-1}s^{-1}$ and $k_2 = 2.56 \times 10^{3}\ e^{-966/T}\ (\pm 15)\ s^{-1}$, at an ionic strength of 0.01 M. Reaction rate is unaffected by incident strong UV radiation, or the presence of Mn(II) or Fe(III), but is weakly dependent on ionic strength. The present results, in comparison with reported rates of oxidation of S(IV) by hydrogen peroxide, indicate that at typical pH levels encountered in nonurban tropospheric cloud water and at representative concentrations of O_3 and H_2O_2 in the troposphere, oxidation by O_3 can be competitive with that by H_2O_2, or possibly even dominate. The reaction appears to proceed by other than a free-radical process, and a reaction scheme involving direct ozone attack catalyzed by hydroxide ion is proposed. A rate expression consistent with this scheme is

$$r = (k_a + k_b[OH^-])[HSO_3^-][O_3]$$

where $k_a = 3.8 \times 10^{5}\ M^{-1}s^{-1}$ and $k_b = 1.05 \times 10^{16}\ M^{-2}s^{-1}$ at 25°C. This expression correlates the present data in conjunction with literature data over the pH range 1.0 to 6.2. (Sulfite oxidation, sulfate formation, ozone, cloud chemistry).
J. Geophys. Res., Green, Paper 3C0416

1410 Chemistry of the atmosphere
CHARACTERIZATION OF THE ATMOSPHERIC AEROSOL OVER THE EASTERN EQUATORIAL PACIFIC
Willy Maenhaut (Institute for Nuclear Sciences, State University of Ghent, Proeftuinstraat 86, B-9000 Ghent, Belgium), Hans Raemdonck, André Selen, René Van Grieken and John W.Winchester

Using a polyester sailboat as sampling platform, a series of duplicate aerosol samples was collected by cascade impactors on a trip from Panama to Tahiti in 1979. Elemental analysis mainly by particle-induced X-ray emission (PIXE) indicated, in the samples collected between Panama and the Galapagos Islands, the presence of a substantial crustal component (~ 0.4 μg/m³), fine Cu (~ 0.4 ng/m³) and Zn (~ 0.6 ng/m³), and excess fine S and K (~ 100 and ~ 2.4 ng/m³, respectively) in addition to the major sea salt elements. The crustal component and fine Cu and Zn are suggested to result from natural continental sources, i.e. eolian dust transport from the American continents and perhaps geothermal emissions. Samples collected west of the Galapagos Islands in the southern trades, showed significantly lower concentrations for the non-seawater components. The average Si and Fe levels were as low as 4.8 and 3.3 ng/m³, corresponding to a maximum of 0.066 μg/m³ for an assumed mineral dust component, whereas heavy metal concentrations were all below the detection limits (typically ranging from 0.05 to 0.15 ng/m³ for V, Cr, Mn, Ni, Cu, Zn and Se). Excess fine S decreased to a mean of 46 ng/m³, a level similar to those reported for other remote marine and continental locations. This all indicates that the marine atmosphere west of the Galapagos was little influenced by natural continental source processes or by anthropogenic emissions. Under these truly marine conditions, several concentration ratios of the major seawater elements were significantly different from those in bulk seawater. Ca, Sr, and S in > 1 μm diameter particles were enriched relative to K and Na, with the enrichment being substantially more pronounced (up to 50% or higher) for 1-4 μm diameter particles than for particles > 4 μm. Comparison of these data with a similar data set from samples collected over the Atlantic indicates that the departures from seawater composition are significantly larger for the Pacific. Differences in sea-to-air fractionation processes, probably involving binding of divalent cations to organic matter in the oceanic surface microlayer, are suggested as being responsible for those observations. (Aerosols, sea salt, Pacific).
J. Geophys. Res., Green, Paper 3C0417

1410 Chemistry of the Atmosphere
Trace Elements in Marine Aerosol Particles from Enewetak Atoll: 1. Concentrations, Sources, and Temporal Variability
R.A. Duce (Center for Atmospheric Chemistry Studies, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island, 02881), R. Arimoto, B.J. Ray, C.K. Unni and P.J. Harder

The concentrations of twenty-nine elements were measured in aerosol particles collected in 1979 during SEAREX experiments at Enewetak Atoll (11°N, 162°E) in the tropical North Pacific. The concentrations of Na, Mg, Cl, K, Ca, and Br were dominated by marine sources; these elements had similar mass-size distributions, and their atmospheric concentration ratios (normalized to Na) were similar to the corresponding ratios in bulk seawater. Atmospheric inputs of aluminosilicate particles from crustal weathering controlled the aerosol particle concentrations of Al, Sc, Mn, Fe, Co, Cs, Ba, Ce, Eu, Hf, Ta, and Th. Mean concentrations of these crustally derived elements decreased by an average of 91 percent (± 4.1 percent) from the local dry season (April to May) to the wet season (July to August); this general decrease was attributed to the abatement of dust storms in Asia. At times the influx of dust from Asia dominated the concentrations of V, Cr, Rb, and Cu in aerosol particles, but when dust concentrations decreased, non-crustal sources for these elements became apparent. A fourth group of elements (Zn, Se, Ag, Cd, Sb, I, and Pb) exhibited average atmospheric concentrations which were higher than those expected from the flux of sea salt or the dispersal of mineral aerosol particles. Enrichments of these trace elements relative to average crustal material increased as the atmospheric dust concentrations subsided. (Marine aerosol particles, trace elements).
J. Geophys. Res., Green, Paper 3C0415

Hydrology

3125 Glaciology
ON THE DYNAMICS OF THE ICE SHEETS II
P. Halfar (Max-Planck-Institut für Meteorologie, Hamburg, FRG)

The equation which describes the motion of an ice sheet under its own weight has a cylindrically symmetric similarity solution. The initial value problem of the equation of motion which has been linearized in the deviations from this similarity solution is solved by an expansion of the solution in terms of eigenfunctions of the linearized equation. The linearized equation determines for all ice sheets of the same volume an asymptotically stable motion. The results are compared with the corresponding results of the 2-dimensional case.
J. Geophys. Res., Green, Paper 3C0340

Oceanography

4713 Circulation
SOUTHWARD SUBSURFACE FLOW BELOW THE SOMALI CURRENT
D. R. Quadfasel (Institut für Meereskunde, Universität Hamburg, 2000 Hamburg 13, F.R.G.), F. Schott (University of Miami, Florida 33149).

The existence of a southward flowing current beneath the northern part of the seasonally reversing Somali Current is documented in a 2½ year long time series of currents obtained at moored stations near 5°N about 30 km off the Somali coast. Its mean annual transport in the layer 150-600 m amounts to about 5 x 10⁶ m³/s. The undercurrent has a pronounced seasonal cycle in phase with the near surface flow, suggesting a close coupling to the monsoon wind forcing. With the spin-up of the deep-reaching northern Somali gyre after the onset of the southwest monsoon the undercurrent is temporarily destroyed in the northern Somali Basin during June/July but is re-established in August. The undercurrent does not reach 3°N but turns offshore north of that latitude. (Somali Current, undercurrent, Indian Ocean)
J. Geophys. Res., Green, Paper 3C0433

4713 Circulation
VARIABILITY OF CURRENT, TEMPERATURE, AND BOTTOM PRESSURE ACROSS THE WEST FLORIDA CONTINENTAL SHELF, WINTER 1981–1982
G.O. Marmorino (A/S1 Bon Blvd., Tallahassee, Florida, 32301)

Observations are analyzed from four current meter moorings deployed on the broad continental shelf in the northeastern Gulf of Mexico from November 29, 1981, to February 8, 1982 (71 days). Consistent with recent modeling studies, the shelf circulation responds with an inertial period in the alternating up-and-down-coast synoptic scale wind forcing. Average response to a 0.5 dyn cm⁻² alongshore wind stress (as measured at the coast) is ~20 cm s⁻¹ off Cedar Key and ~40 cm s⁻¹ in the north where the shelf narrows (off Cape San Blas). Lower layer currents veer counterclockwise with depth, as in a bottom Ekman layer (e-folding scale ~8 m). The pressure field decays offshore (e-folding scale ~150 km) and yields a geostrophic current in good agreement with the observed alongshelf flow. Cross-shelf and vertical variations of the tidal signals compare nicely with results from barotropic theory. Calculations indicate that most of the shoreward propagating tidal energy may be dissipated in depths of <20 m (within 50 km of shore).
J. Geophys. Res., Green, Paper 3C0018

Particles and Fields—Interplanetary Space

5360 Solar Wind Interaction with Moon and Planets
ON THE NATURE OF THE INTERACTION OF THE JOVIAN MAGNETOSPHERE WITH THE ICY GALILEAN SATELLITES
R. S. Wolff (Space Physics Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109), D. A. Mendis

The nature of the interactions between the Jovian magnetosphere and Europa, Ganymede, and Callisto are examined. Effects of plasma and micrometeoroid bombardment of each satellite are considered in an attempt to understand the influences of exogenic processes on the surface properties of each of the three moons. Earth-based infrared observations of satellite surface temperatures are used as a basis to calculate (estimated) H_2O vapor pressures for each of the three satellites as a function of satellite latitude and local time. Sublimating H_2O leads to a net O_2 atmosphere at each of the three moons, and the effectiveness of such an atmosphere in preventing the Jovian plasma from reaching each satellite surface is considered under a variety of magnetospheric conditions. The effects of the magnitude and orientation of possible satellite magnetic fields were also studied and used to estimate the properties of the satellite magnetospheres under conditions appropriate to each moon both inside and outside the Jovian plasma sheet. Using Pioneer plasma, energetic particle, and magnetic field data, these satellite atmospheric and magnetospheric calculations were then used to determine the (energy dependent) distribution of Jovian magnetospheric plasma over each satellite surface. In addition, the orbits of charged micrometeoroids in Jupiter's magnetosphere were examined to determine the flux of particles hitting the surfaces of each of the three satellites. Finally, possible observational effects of (geological time periods) plasma and micrometeoroid bombardment of the satellite surfaces are considered and compared with available laboratory simulations and Earth and space-based observations of Europa, Ganymede and Callisto. These efforts suggest that plasma and micrometeoroid bombardment of the icy Galilean satellites could act to substantially modify the surface properties of each of the three moons, resulting in "leading-trailing" asymmetries in the satellite surfaces not unlike those observed in the satellites' spectral and polarization properties. (Galilean satellites, Jovian magnetosphere).
J. Geophys. Res., Blue, Paper 3A0138

Particles and Fields—Ionosphere

5530 High Latitude Ionospheric Currents
IONOSPHERIC AND BIRKELAND CURRENT DISTRIBUTIONS INFERRED FROM THE MAGSAT AND MAGNETOMETER DATA
C. J. Zanetti, (Applied Physics Laboratory, Johns Hopkins University, Laurel, Maryland 20707), W. Baumjohann and T. A. Potemra

The MAGSAT vector magnetometer data, with the aid of an accurate magnetic field model, have been used to infer ionospheric and field-aligned sheet current density distributions. The method emphasized here consists of a Fourier transform technique developed for use on surface magnetometer data and recently used by Baumjohann et al. (1979). Data acquired by MAGSAT on two days in 1979 were analyzed in detail. The first was Dec. 21, 1979, a reasonably quiet (Σ K_p = 8-) time in the southern hemisphere, whereas the second example deals with a rather active time, Nov. 13, 1979 (Σ K_p = 35+) in the northern hemisphere. Important results of this study include the fact that the Birkeland and electrojet current systems are colocated. In addition, more realistic ionospheric current distributions have been developed. The analyses have shown a tendency for triangular rather than constant electrojet current distributions as a function of latitude, which is also consistent with the statistical, uniform Region 1 and Region 2 Birkeland current patterns.
J. Geophys. Res., Blue, Paper 3A0393

5530 High-latitude ionospheric currents
FIRST VHF AURORAL RADAR INTERFEROMETER OBSERVATIONS
J. P. Providakes (School of Electrical Engineering, Cornell University, Ithaca, New York, 14853), W. E. Swartz, D. T. Farley, and B. G. Fejer

The radar interferometer technique first used at the magnetic equator in Peru is also a very powerful means for studying auroral plasma instabilities. We present here the first results, obtained with a 49.92 MHz, 20-25 KW peak power pulsed radar located in Ithaca, NY (42.5° N, 76.4° W). Strong auroral echoes were obtained during several highly active periods. Phase differences between the signals received on the two antennas accurately determine the E-W position, within the scattering volume, of localized scattering centers, and changes in this phase determine the corresponding velocity. The signal Doppler shift describes radial (essentially N-S) motion. The data provide detailed information on the turbulent structure of the echoing region and show clearly that different features in the Doppler power spectrum often represent signals coming from different locations. If we assume that the radial and transverse phase velocities represent real drift velocities, we can determine full horizontal velocity vectors from the data and hence the horizontal electric field, usually with a time resolution of the order of 15-30s.
Geophys. Res. Lett., Paper 3L0330

5590 Instruments and techniques (Particles and Fields-Ionosphere)
A THEORY OF COHERENT RADAR SPECTRA IN THE AURORAL E REGION
J.-P. St.-Maurice (Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah 84322), Kristian Schlegel

We have developed a theory of auroral radar spectra for conditions under which Farley-Buneman waves should be strongly excited in the high latitude E region. The theory assumes that the unstable waves spend the larger part of their lifetime in a linear growth phase. It also uses a previously unexplored property of the waves, namely that waves with different wave vector components along the magnetic field have markedly different phase velocities. We have constructed synthetic auroral radar spectra for 1 m size irregularities. We have calculated the width of the spectra, their mean Doppler shift, and anisotropy. We have studied how the properties of spectra produced by Farley-Buneman waves are affected by the presence of ion drifts and neutral winds, by the electron temperatures and densities, by the neutral atmospheric profile and the by strength of the DC electric fields. The results seem to be in good qualitative agreement with existing observations.
J. Geophys. Res., Blue, Paper 3A0366

Particles and Fields—Magnetosphere

5733 Magnetic storms
MAGNETIC FIELD LINE RECONNECTION 5. CURRENT DISRUPTIONS AND DOUBLE LAYERS
R.L. Stenzel (Department of Physics, University of California, Los Angeles, CA, 90024), W. Gekelman and N. Wild

In a large laboratory plasma a current sheet is generated in the process of magnetic field line reconnection. The stability of the sheet with respect to local current increases is investigated. When the current density in the center of the sheet exceeds a critical value, spontaneous local current disruptions are observed. The current from the center of the sheet moves out to the sides. Magnetic flux variations in regions remote from the current sheet generate an inductive voltage in the current loop which drops off inside the plasma in the form of a potential double layer. This leads to particle acceleration with velocities much larger than those expected from the steady state electric fields in the plasma. The particle beams acquire their energy on expense of the stored magnetic field energy of the current system. Beam-plasma instabilities are generated which dissipate some of the directed kinetic energy and heat the back ground plasma. A model for the mechanism of the current disruptions is formulated. The potential structure leads to ion expulsion creating a localized density drop. The associated current drop in an inductive circuit drives the potential structure, thereby providing feedback for the disruptive instability. It saturates at a total current loss upon which the current system recovers, and the process repeats randomly. Similarities and differences to magnetospheric substorm phenomena are pointed out. (Reconnection, double layers, current disruptions, particle energization).
J. Geophys. Res., Blue, Paper 3A0428

5765 Plasma instabilities
OBSERVATIONS OF LHR NOISE WITH BANDED STRUCTURE BY THE SOUNDING ROCKET S29 BARIUM-GEOS
Hannu E. J. Koskinen (Uppsala Ionospheric Observatory, S-75590 Uppsala, Sweden), Gunnar Holmgren, and Paul M. Kintner

The density fluctuation and electric field data from the Swedish sounding rocket S29 Barium-GEOS shows a broad electrostatic noise band near the lower hybrid frequency. The noise is related to the spin of the rocket and extends well below the local lower hybrid resonance frequency. Above the altitude of 300 km the noise shows banded structure roughly organized by the hydrogen cyclotron frequency. Simultaneously with the banded structure a signal near the hydrogen cyclotron frequency is detected. This signal is also spin modulated. The character of the noise is discussed in comparison with the probable free energy sources and it is suggested that the noise is locally generated by the rocket payload disturbing the plasma. If this interpretation is correct, we expect plasma wave experiments on other spacecrafts to observe similar phenomena. (Lower hybrid resonance, density fluctuations, free energy source).
J. Geophys. Res., Blue, Paper 3A0126

5799 General (Upstream Energetic Ions)
DEPENDENCE OF 50 keV UPSTREAM ION EVENTS AT IMP 7/8 UPON MAGNETIC FIELD-BOW SHOCK GEOMETRY
D. G. Mitchell (Applied Physics Laboratory, Johns Hopkins University, Laurel, Maryland, 20707) and E. C. Roelof

We present the results of a statistical study of 4 years (1972-1976) of IMP 7 and 8 observations at ~ 40 R_E of 50-200 keV upstream ion events measured with the JHU/APL Energetic Particle Experiment. We find a monotonic increase in the probability of observing upstream particle events with a decrease in the angle (θ_{Bn}) between the interplanetary magnetic field (IMF) and the local shock normal at the point where the IMF intersects the bow shock, independent of the length of time of bow shock connection (if it exceeds ~ 10 minutes). We find roughly equal probability of observing an event above a given flux from any portion of the bow shock with the same value of θ_{Bn}, a growth time of the 50 - 200 keV events of ~ 10 minutes, a maximum attainable flux of ~ 2.5 x 10⁴ (cm² s sr)⁻¹, and a positive correlation between the probability of exceeding a given flux and the 3-hour K_p index. The results imply that the local structure of the bow shock in the immediate vicinity of the field line connection is the dominant influence in the generation process of energetic upstream particle events, and that wave-particle interactions produce a self-throttling mechanism that limits the maximum flux of ions escaping the upstream foreshock.
J. Geophys. Res., Blue, Paper 3A0399

5799 General (Upstream Energetic Ions)
ISEE-3/IMP-8 OBSERVATIONS OF SIMULTANEOUS UPSTREAM ION EVENTS
D. G. Mitchell (Applied Physics Laboratory, Johns Hopkins University, Laurel, Maryland, 20707), E. C. Roelof, T. R. Sanderson, R. Reinhard and K.-P. Wenzel

Propagation of upstream energetic (50-200 keV) ions is analyzed in sixteen events observed simultaneously by solid-state detectors on ISEE-3 at ~ 200 R_E and on IMP-8 at ~ 35 R_E from the Earth. Conclusions are based on comparisons of the pitch angle distributions observed at the two spacecraft and transformed into the solar wind frame. They are beam-like at ISEE-3, and confined to the outward hemisphere. When IMP-8 is furthest from the bow shock they are also usually beam-like, or hemispheric. However, when IMP-8 is closer to the bow shock, pancake-like distributions are observed. This systematic variation in the IMP-8 pitch angle distributions delimits a scattering region $\ell \lesssim 15$ R_E upstream of the Earth's bow shock (ℓ measured along the interplanetary magnetic field) which dominates ion propagation, influences the global distribution of fluxes in the foreshock, and may play a role in acceleration of the ions. When IMP-8 is beyond ℓ ~ 15 R_E, the propagation appears to be essentially scatter-free between IMP-8 and ISEE-3; this is deduced from the absence of earthward fluxes at IMP-8 as well as the tendency for the spin-averaged fluxes to be comparable at the two spacecraft.
J. Geophys. Res., Blue, Paper 3A0398

Physical Properties of Rocks

6110 Elasticity, fracture and flow.
BEDROCK FRACTURE PARAMETERS FROM THE INTERPRETATION OF WELL TIDES.
Don R. Bower (Department of Energy, Mines and Resources, Earth Physics Branch, Gravity, Geothermics and Geodynamics Division, 1 Observatory Crescent, Ottawa, Ontario, Canada. K1A 0Y3)

This paper presents a theory to account for the main features of the tidal response of an isolated plane fracture as revealed by the water level in an intersecting open borehole. According to the theory, the diurnal and semidiurnal tidal constituents (both amplitude and phase) of water level variations depend on the fracture aperture, the orientation (dip and strike) and the radial extent of the fracture, and the compressibility of the asperities. The theory is applied to water level observations made in six open boreholes located in crystalline rock at a test site at the Chalk River Nuclear Laboratories, Atomic Energy of Canada Limited in Chalk River, Ontario, Canada. The boreholes were uncased and intersected many open fractures so that a definitive test of the theory could not be made. However, in four cases a fracture model could be found which fitted the observations within the experimental error.
J. Geophys. Res., Red, Paper 3B0429

6110 Elasticity, Fracture and Flow
STRESS CORROSION AND CRACK PROPAGATION IN SIOUX QUARTZITE
Lindamae Peck (Department of Geology and Geophysics, Yale University, New Haven, Connecticut, 06511)

Water-induced changes in the amount of specific energy (energy per unit area) consumed during crack extension in Sioux quartzite were determined using the analysis of linear elastic fracture mechanics. Wedge-loaded double cantilever beam test specimens were cracked in air, water, and aqueous solutions of NaOH, HCl, NaCl and methanol at crack velocities of 4.2 x 10⁻⁵ to 4.2 mm/s and temperatures of 17–60°C. Scanning electron microscopy and the determination of enhanced permeability were used to detect fracture-induced microcracks.

The fracture energy of Sioux quartzite in water is 15% lower than that of quartzite cracked in air (ambient humidity). The dependence of the fracture energy on crack velocity (time) and on the concentration of water in the test environment is characteristic of the occurrence of stress corrosion as a mechanism of enhanced crack growth in the presence of water. Increased crack velocity in quartzite cracked in hot water is evidence of thermally enhanced water-weakening, but the fracture energy of quartzite cracked in hot air or hot water (40-60°) is 12-13% higher than room temperature values. The increase in fracture energy upon heating the quartzite is attributed to changes (reduction in residual stress, existence of thermal stresses) in the net stress field responsible for microcracking and crack propagation in the quartzite. (Stress corrosion, crack propagation).
J. Geophys. Res., Red, Paper 3B0412

6120 Equations of state
SHOCK COMPRESSION OF DIAMOND CRYSTAL
K. Kondo and T. J. Ahrens (Seismological Laboratory 252-21, California Institute of Technological Laboratory, Pasadena, California 91125)

Two shock wave experiments employing inclined mirrors have been carried out to determine the Hugoniot elastic limit (HEL), final shock state at 191 and 217 GPa, and the post-shock state of diamond crystal, which is shock-compressed along the intermediate direction between the <111> and <110> crystallographic axes. The HEL wave has a velocity of 19.9 ± 0.3 mm/μsec and an amplitude of 63 ± 28 GPa. An alternate interpretation of the inclined wedge mirror streak record suggests a ramp precursor wave and then another HEL value. The maximum post-shock density achieved upon release from the ~200 GPa shock state is ~3.95 Mg/m³. This result suggests initial density 3.52 Mg/m³. This result suggests an elastic unloading effect or shock-induced transition to a denser (possibly metallic) phase. (Diamond, phase change, failure).
Geophys. Res. Lett., Paper 3L0262

6199 General (Flow in Fractures)
DISPERSION IN TRACER FLOW IN FRACTURED GEOTHERMAL SYSTEMS
R. N. Horne (Petroleum Engineering Department, Stanford University, California, 94305), F. Rodriguez-G.

Interpretation of tracer tests is commonly based on the analysis of flow through a porous medium. In geothermal reservoirs however the principal permeability arises from fractures, and a porous medium approach is not applicable. The dispersion of tracer material flowing in a fracture is shown to be dominated by molecular diffusion across the fracture - a mechanism known as Taylor dispersion. For typical values of reservoir parameters, this transverse diffusion will obliterate any transverse tracer concentration gradients caused by the velocity profile across the fracture. The effective dispersivity is found to be a function of fracture aperture, mean flow velocity and molecular diffusivity, and is orders of magnitude greater than for porous medium flow. Typically Peclet numbers are anticipated to lie between orders 1 and 100, and field results confirm this range. (Dispersion, tracer, geothermal, fractures)
Geophys. Res. Lett., Paper 3L0351

Planetology

6510 Atmospheres of planets
DAY AND NIGHT MODELS OF THE VENUS THERMOSPHERE
S.T. Massie (Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721), D.M. Hunten, D.R. Sowell

A model atmosphere of Venus for altitudes between 100 and 178 km is presented for the day and night sides. Densities of CO_2, CO, O, N_2, He, and O_2 on the day side, for 8 and 16 hours local time, are obtained by simultaneous solution of continuity equations. These equations couple ionospheric and neutral chemistry, and the transport processes of molecular and eddy diffusion. Photodissociation and photoionization J coefficients are presented to facilitate the incorporation of chemistry into circulation models of the Venus atmosphere. Midnight densities of CO_2, CO, O, N_2, He, and N are derived from integration of the continuity equations, subject to specified fluxes. The night side densities and fluxes are consistent with the observed airglow of NO and $O_2(^1\Delta)$. The homopause of Venus is located near 133 km on both the day and night sides.
J. Geophys. Res., Blue, Paper 3A0196

6510 Atmospheres of Planets
IO'S ATMOSPHERE: PRESSURE CONTROL BY REGOLITH COLD TRAPPING AND SURFACE VENTING
Dennis L. Matson and Douglas B. Nash (Earth and Space Sciences Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109)

A new model for the basal pressure of Io's atmosphere is developed. This model takes into account the previously ignored fact that much of Io's surface has very high porosity, typically ~ 90%. Such porosity allows efficient, subsurface cold trapping of atmospheric gases which tends to keep ambient surface pressures very low. SO_2 is the only gas identified on Io and the basal pressures for atmospheric models are usually pegged to local surface temperature via the SO_2 vapor-pressure equilibrium curve. Near Io's subsolar point the pressure in equilibrium with a surface SO_2 frost deposit is ~ 10⁻⁷ bar. Porous surface models of the type we develop invoke equilibrium with the colder, subsurface permafrost (at ~ 3 cm depth) and yield pressures of ~ 10⁻¹² bar. The subsurface cold trapping model explains many but not all observations relevant to Io's atmosphere. The new basal pressure model and the earlier surface frost equilibrium model, when taken together, provide, respectively, lower and upper limits on the basal SO_2 pressure of Io's atmosphere. (Io atmosphere, Io surface, sulfur-dioxide, regolith, coldtrapping).
J. Geophys. Res., Blue, Paper 3A0365

Seismology

6940 Phenomena (Earthquake prediction)
RADON AND TILT ANOMALIES DETECTED BEFORE THE IRPINIA (SOUTH ITALY) EARTHQUAKE OF NOVEMBER 23, 1980 AT GREAT DISTANCES FROM THE EPICENTER.
L. Allegri, F. Bella, G. Della Monica, A. Ermini, S. Improta, V. Sgrigna and P.F. Biagi (Istituto di Fisica, Universita' di Roma, P.le A. Moro 2, 00185 Roma, Italy)

A strong earthquake (M=6.5) occurred on November 23, 1980 in South Italy (Irpinia region) at hypocentral depth ranging between 10 Km and 18 Km. Anomalous variations in groundwater radon content, 25% and 170% compared with the background level, were detected at Rome and Rieti sites before the earthquake. A tilt anomaly, 20 rad in amplitude, was observed at L'Aquila site. All the stations were located at distances of about 250 Km from the epicenter. The anomalous duration, for both the examined parameters, lasted five-six months. We suggest to interpret such anomalies as precursors of the Irpinia earthquake. (Radon, tilt, earthquake prediction).
Geophys. Res. Lett., Paper 3L0307

6950 Seismic sources (mechanisms, magnitude, frequency spectrum, space, and time distribution)
BREAKING OF A SINGLE ASPERITY: RUPTURE PROCESS AND SEISMIC RADIATION
S. Das (Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964) and B. V. Kostrov

The problem of spontaneous shear rupture of a single circular asperity on an infinite fault plane is studied. Initially, the fault plane is broken everywhere except at a circular asperity. An applied displacement at infinity results in a stress concentration along the bounding edge of the asperity. The frictional stress on the broken part of the fault plane is taken to be a constant. Once a point on the asperity breaks, the stress there drops to the same value as on the 'main' fault surface. The rupture is started by relaxing the shear stress at a point on the asperity edge and is then allowed to propagate spontaneously using a critical stress level fracture criterion. The rupture process is calculated numerically. It is found that for asperities of constant strength, the rupture first propagates around the edge of the asperity and then inward, a phenomenon best described by the well-known term of classic military maneuver - 'the double encircling pincer movement'. In the appendix, the expressions for the far-field seismic radiation due to the rupture of such an asperity are derived. It is shown that the n-th cartesian component of the far-field displacement at (x,t) for P, SV and SH waves, using the notation of Aki and Richards [1980], is given by

$$u_n(\vec{x},t) = \frac{D_{nl}}{4\pi\rho c^3 R}\iint_{S_0} \dot{\tau}_{3l}\left(\vec{\xi}, t - \frac{R - \vec{\xi}\cdot\vec{\gamma}}{c}\right) dS(\vec{\xi})$$

Thus, the far-field pulses can be directly found from the stress-drops on the fault-plane. This formula is also true for 'crack' or 'dislocation' problems. The directivity function D_{nl} for displacement for the asperity problem is found to be that for the double couple, modified by some factor. In particular, the fault plane is a nodal plane for SV waves. (Circular asperity, rupture, seismic radiation).
J. Geophys. Res., Red, Paper 3B0269

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